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Treatment of anxiety disorder with neurofeedback: case study

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Abstract

The objective of the present study is to report the effects of beta-increase and alpha- increase EEG feedback training along with alpha-theta biofeedback training in two patients diagnosed with anxiety disorder. The Symptom Checklist-90-Revised (SCL-90-R) and patients' self reports were used as objective measures of treatment efficacy. Following 30 sessions of EEG biofeedback within a three-month period, patients reported a significant reduction in anxiety-related symptoms. At one-year follow-up, results of SCL-90-R showed all clinical scales within normal range. In addition, self-reports confirmed that the patients were symptom free. In general, the current study findings demonstrated that neurofeedback was an effective treatment for anxiety disorder.

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Keywords: Neurofeedback; EEG biofeedback; Anxiety Disorder, Ttreatment Introduction

1. Introduction

Studies show in addition to traditional treatments of anxiety such as psychotherapy and medical approach, biofeedback training can also be applied in the treatment of patients diagnosed with anxiety. The early history of EEG biofeedback in the treatment of psychological disorders was based on the observations of individuals in altered states of consciousness (Schwartz, 1987). Based on these observations, biofeedback focused on increasing activity of alpha wave for patients diagnosed with anxiety. Hardt and Kamiya (1978) showed that biofeedback training to increase EEG alpha wave had a distinct influence in anxious college students. Dong and Bao (2005) in their biofeedback study on 70 students diagnosed with high levels of anxiety, assigned 35 of the students in experimental group and 35 of them in control group and reported a significant improvement in anxiety-related symptoms, somatisation, and depressive symptoms in the treatment group compared with the control group when biofeedback sessions were carried out for them. In a study, frontal EMG biofeedback was compared to EEG biofeedback training (either to increase or decrease activity of alpha wave) and, although all the training methods were effective in reducing anxiety, only subjects who received alpha-increase biofeedback significantly showed reductions in the rate of heart reactivity to stressors at a separate psycho-physiological testing session (Rice et al., 1993, p. 93).Vanathy et al. (1998) in their study applied EEG biofeedback to generalized anxiety disorder, and compared increased alpha activity with increased theta activity. They found the two procedures were both effective in decreasing symptoms. Alpha/theta neurofeedback allows one to gain control over low-frequency EEG activity and remain in a state of deep

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relaxation without falling asleep. It has been shown to have clinical benefits in the treatment of alcoholism (Egner & Gruzelier, 2003). In healthy individuals; it has been shown to improve artistry in students who study music (Hammond, 2003). Originally Alpha/theta neurofeedback was designed to induce hypnogogia, a state historically associated with creativity. Another outcome reduced depression and anxiety in alcoholism and resolved post traumatic stress symptoms.

We have also successfully treated two patients suffering from chronic anxiety who exhibited abnormally low levels of beta and alpha activity and abnormally high levels of beta 2 by training them to increase alpha and beta and to inhibit beta2. The following case studies were selected for two reasons: (a) The patients had a lifelong history of symptoms of moderate to severe anxiety, and (b) The patients, were handled with a variety of treatment modalities in different clinics over their lifetime without sufficient outcomes, before initiation of EEG biofeedback training. In addition, we were able to follow up with the patients to assure maintenance of recovery. The purpose of these 2 case studies is to show that alpha and beta increase EEG training is effective in treating anxiety when the patients already exhibit abnormally low alpha and beta wave activities and to suggest a distinct treatment for anxiety.

2. Method

2.1. Sample

The first patient was a 28-year-old single male from high socio economic status, working in an oil refinery factory. His current complaints included nervousness, anxiety, aggressive behavior, phobia, OCD, ruminative thought and low self-confidence experience. The patient reported that the current anxiety symptoms initiated 10 years ago.

The second patient was a 20-year-old single female from high socio economic status, presenting complaints included anxiety, aggression, nervousness, ruminative thought, feeling high sensitivity to others' words, worrisome and tension. A medical evaluation for each patient showed no physical reason for presenting the complaints.

2.2. Measures

The SCL-90-R is a 90-item self-report inventory of adult psychological symptoms including 9 symptom dimensions e.g. Somatization, Obsessive-Compulsive, Interpersonal Sensitivity, Depression, Anxiety, Hostility, Phobic Anxiety, Psychoticism and Paranoid Ideation. This measure has a high test-retest reliability and internal consistency. It has also high concurrent, convergent, discriminated, and constructs validity (Derogatis, Rickels, & Rock, 1976).

This scale was administered during the course of therapy: (a) the first at initiation of therapy, (b) the second at the end of EEG biofeedback training, and (c) the third at one year follow-up. This measure was selected as a means of evaluating the patient's complaints and assessing the effectiveness of treatment. In addition, self-reports and interviews with the patients were used at the end of EEG training and at follow-up to further evaluate the efficacy of the therapy.

2.3. Treatment

Previous treatments of these patients consisted of psychopharmacological interventions with no significant relief of symptoms. We introduced the patients to EEG feedback training. Neurofeedback therapy was held in 10 weeks and in each week, we had three 50-minute sessions of neurofeedback for each patient. Before starting the first session, EEG registrations in different brain regions included central regions (Cz, C3 and C4), in frontal regions (Fcz, F3 and F4) and in parietal region (Pz) identified by procomp2. EEG registration was conducted by 1 connected electrode to head and 2 connected electrodes to earlobes. EEG was conducted in 6 different frequency bands of delta (1-4 Hz), theta (4-8 Hz), SMR (12-15 Hz), beta (15-18 Hz), alpha (8-12 Hz) and beta2 (20-33 Hz). The results showed that alpha in mid-parietal (Pz) and beta in mid-frontal (Fz) of the brain were lower compared with normal

individuals. Alpha amplitude in the back of head was (2-3 Hz) and beta in front of the head was (1.2-1.5 Hz). In normal individuals, alpha wave amplitude in the back of head with open eyes was approximately (7-9 Hz) and mean of beta in frontal region was approximately (4-5 microvolt). Deviation in the activity of these waves from normal state results in anxiety, restlessness, lack of concentration and sleep disturbance. Moreover, the results of initial assessment showed that in central, frontal and parietal brain regions of the patients, beta 2(20-33 Hz) was high (amplitude was greater than 15 Hz). High amplitude of this wave in brain is the indicator of anxiety and restlessness. Based on these observations, we reinforced beta (15-18 Hz) in (Fz) and alpha in (Pz). Considering beta 2(20-33 Hz) in both regions were high, we reinforced alpha and beta and at the same time, inhibited beta activity. In other words, in each session, reinforcing alpha and inhibition of beta2 in Pz were carried out in 25 minutes and reinforcing beta and inhibition of beta2 in Fz were carried out in 25 minutes at the same time. The types of neurofeedback programs were audio-visual feedbacks including different film and animation clips. We gave a short break to subject if he/she reported tiredness. In the beginning of each session, 2 minute baselines were taken and thresholds were set. Thresholds were set in a way that if subjects were able to maintain simultaneously reinforced beta or alpha band lower for at least 0.5 seconds than threshold at 60% and inhibited beta2 band at 20%, they received more reinforcement of audio or visual neurofeedback.

If the patient was able to maintain reinforced band higher than the defined threshold in 2 consecutive attempts at 90%, the threshold became more difficult. From session 20, improvement in amplitude alpha in the back of head and improvement in beta in front of head were observed. Alpha in (Pz) of the subjects was approximately 7 Hz and beta amplitude was approximately 3.5-4 Hz. Moreover, self reports of the patients indicated lower aggression, and less anxiety, phobia and ruminative thought. Alpha-theta protocol in (Pz) was applied for giving mental calmness and mood improvement in the patients. In this protocol, each subject was asked to listen to the sound of an occasion and think simultaneously to a personal painful memory, life ambitions and find probable solutions for settling that bad memory. Alpha and theta were set in a way to be higher than the threshold at 70% and beta was higher than the threshold at 20%. In this task, either reinforcement or inhibition was presented but we tried to help the patients find the ability to regulate alpha and theta activities and do problem-solving with thinking to past painful memories and their negative consequences. We should mention that other study protocols continued for stability in the treatment sessions by the end of the sessions and we allocated 15 minutes to reinforce alpha in (Pz) and 15 minutes to reinforce beta in (Fz) and allocated 20 minutes to alpha-theta protocol in (Pz) in the last 10 sessions.

3. Results

Subject 1

Before treatment, SCL-90-R was completed for subject1. As shown in Figure1, the subject's scores in SCL-90-R subscales e.g. hostility, anxiety, phobic anxiety, OCD, depression, somatization and interpersonal sensitivity were high before treatment but after treatment with neurofeedback and follow-up, the severity of symptoms significantly decreased which involved the subject' self reports on recovery from anxiety-related symptoms. In sessions 7 and 8 he reported significant reductions in anxiety-related symptoms and aggressive behaviors and increase in feeling mental calmness. Compared with baseline, he reported lower anxiety, anger, ruminative thought, OCD and also after the last 10 sessions of treatment, significant improvements in mood and motivation increased. At 1 year follow-up he reported continued feeling of mood recovery and reported no relapse due to anxiety-related symptoms as also shown in Figure1.

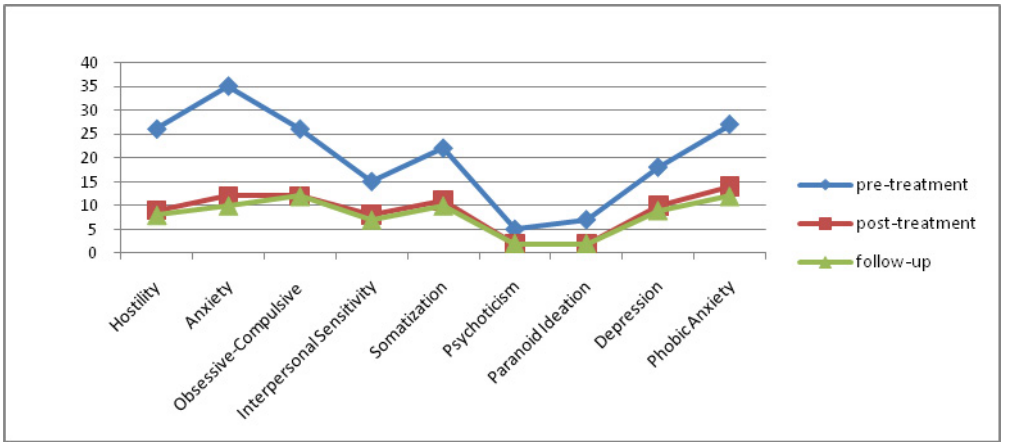

Figure 1. Profile of SCL-90-R scale in subject1 (pre and post neurotherapy and follow-up)

Subject 2

As shown in Figure2, before treatment, the subject's received scores in some SCL-90-R subscales e.g. hostility anxiety, interpersonal sensitivity and depression were high but after treatment with neurofeedback and follow-up the severity of anxiety-related symptoms decreased which were also consistent with the self reports of the subject 2 in experiencing recovery from anxiety and its symptoms. In fact, Subject2 reported calmness and reducing anxiety related symptoms and ruminative thought from session 9. Compared with baseline and based on the self reports o this subject, she experienced improvement in anxiety, hostility and reducing interpersonal sensitivity. She reported significant improvement in mood, and motivation increased in the last session when alpha-theta protocol increased At 1 year follow-up, she reported continued reporting mood recovery and reported no relapse due to anxiety-related symptoms as shown in Figure2.

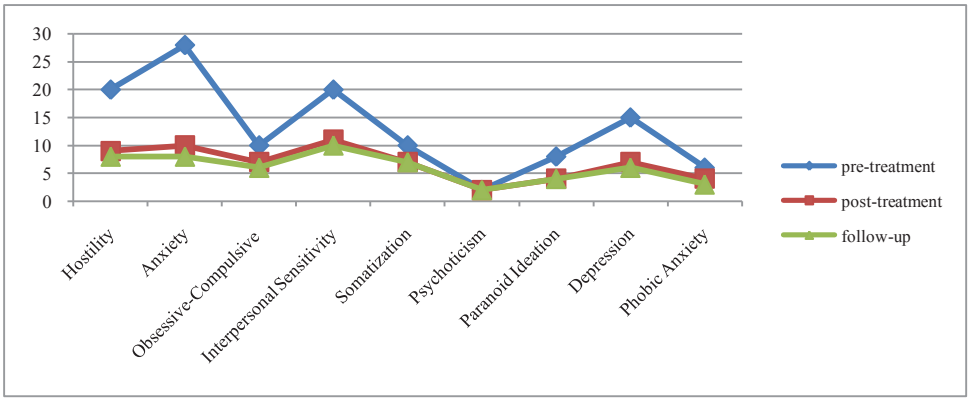

Figure 2. Profile of SCL-90-R scale in subject2 (pre and post neurotherapy and follow-up)

4- Discussion

In this study, we found EEG alpha-increase. EEG beta-increase protocols and trainings are beneficial for patients who exhibit low amplitude alpha and beta. Beta waves (15-18 Hz) are responsible for thinking, concentration and maintaining concentration that are mainly produced by the frontal lobe. Low amplitude beta in this lobe results in lack of concentration, attention and presence of ruminative thought. On the other hand, increase in amplitude beta2

(20-33 Hz) results in restlessness and anxiety. The self-reports of the patients showed concentration improved and ruminative thought, OCD, anxiety and anger reduced which can be associated with improving of amplitude beta in frontal lobe and decreasing beta2 in brain.

Alpha wave is mainly produced by the parietal and occipital lobes. Different studies have shown that low or high alpha amplitude results in anxiety and sleep disturbance. Plotkin and Rice (1981) found that EEG alpha increase and decrease had an anxiety-reducing effect on a similar group. In fact, applying alpha increase and alpha decrease protocols for patients diagnosed with anxiety disorder is dependent on the rate of alpha amplitude in brain especially in parietal and occipital lobes. If amplitude alpha is low, alpha reinforcement could result in reducing anxiety-related symptoms. If amplitude alpha is high, alpha reduction could result in anxiety-related symptoms. In the present study, alpha in parietal lobes of the patients was extremely low so alpha increase protocol was applied. Complementary alpha-theta protocol that we contrived, resulted in patient' mental calmness which was associated with theta. In this protocol, we confronted the patients with their unconscious and deep thoughts in mental calmness state and substantially removing tension and negative effects of past memories. The objective of this task was to increase the rate of theta and alpha waves and leaving the patient in theta state and confronting the patient with painful memories and solving them which is consistent with the studies of Raymond et al. (2005) and Egner et al. (2002). Patients reported deep and stable mental calmness after applying this protocol. It should be noted that the same therapist carried out the treatment procedure for both patients. Therefore, the improvement in the patients' symptoms can be attributed to protocols of treatment, and not to the therapist effect.

Conclusion, current research demonstrated that neurofeedback is an effective modality of treatment for anxiety disorder but lack of control group and lack of placebo were great limitations to the present study which are subject to future studies. A controlled study on a larger sample population is suggested and our observations are only suggestive of the need for a differential approach.

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